DEFORMATION FEATURES OF THE CRETACEOUS UNITS OF THE ICDP-CHICXULUB DRILL CORE YAX-1. T. Kenkmann[1], A. Wittmann[1], D. Scherler[1], R. T. Schmitt[1], Institut für Mineralogie, Museum für Naturkunde, Humboldt-Universität zu Berlin, Invalidenstr. 43, D-10115 Berlin, Germany, thomas.kenkmann@rz.hu-berlin.de

Introduction: The Yaxcopoil-1 (Yax-1) borehole, 60 km SSW of the center of the Chicxulub crater, penetrated through 600 m of sediments below the impactites (from about 894.9 m to the lowermost drilling depth of 1510.9 m). These rocks which are most likely of Cretaceous age are deformed to various degree and consist of distinct lithologies, predominantly carbonates and sulfates (dolomite, limestone and anhydrite). Based on the drill core´s position between the inner peak ring and the crater rim and considering structural information of other large impact craters (e.g. Ries; Siljan), the sequence of Cretaceous rocks most likely represents displaced mega-block units of the crater floor which have been slumped from the rim of the transient crater towards their present position. To test this hypothesis, in particular the autochthonous or allochthonous character of the sediments, information on (a) the spatial extent of the rocks, (b) the inclination of bedding planes and (c) all types of deformation features are required.

Structural analysis of the Cretaceous Sediments: *(a) Spatial extent of sediments.* Seismic reflection data, e.g. the *Chicx-A* seismic section [1], do not directly transsect the *Yax-1* locality and, thus, provides no additional information on the spatial distribution of the sediments of the drillcore.

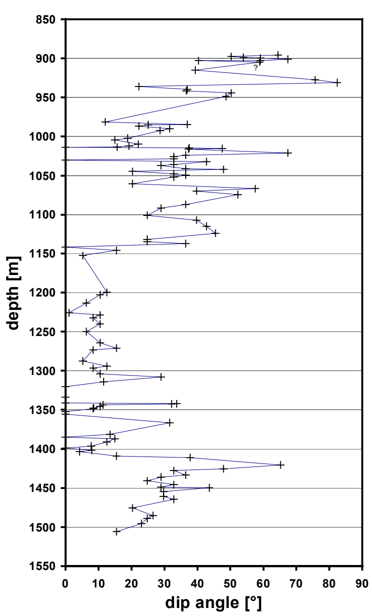

Fig. 1 Inclination of bedding planes with depth

depth interval [m]	mean inclination [°]	standard deviation [°]
895-916	54.8	9.3
936-1137	32.3	13.3
1140-1409	10.0	8.6
1410-1510	32.3	11.0

Table 1: Mean inclination of certain depth intervals

(b) *Tilting*. The inclination of bedding planes is illustrated in Figure 1. The scattering of the dip angle can partly be attributed to the non-horizontal deposition of sediments in a sabkha and shallow marine viroment and to the gypsum-anhydrite dehydration with subsequent growth of nodular anhydrite during diagenesis. Nevertheless, a different degree of tilting can be deduced for certain depth intervals (Fig. 1, Table 1) and may indicate displacement of different blocks. A pronounced change in dip occurs at ~916 m, which correlates with the occurrence of a suevitic dike, and at ~1140 m and ~1410 m. For the latter two changes no shear zones were found which terminate possible displaced block units. Alternatively, synsedimentary slumping events may have caused the different degree of tilting within the sedimentary sequence.

(c) *Deformation features*. The sedimentary stratification is cut off discordantly by several dikes, including suevitic dike breccias, clastic dike breccias and impact melt dikes. Suevitic dikes transsect carbonate host rocks at the top of the megablock at 910 m and 916 m, an impact melt dike occurs at 1347 m. Clastic dike breccias exist at different levels e.g. at 1314-1316 m, 1341 m, and 1398-1399 m. Pseudotachylites have not been discovered.

Shear zones and brecciated rocks are frequent in the Cretaceous rocks but the overall stratification appears intact. A pronounced concentration of deformation occurs near the top of the succession at a depth of 900-920 m, and at 1310-1400 m. The intensity of deformation, the geometry of shear zones, and the degree of deformation localization, was analysed quantitatively using the image analysis software *Leica Q-win.* The deformation characteristics vary as a function of lithology (Figs. 2, 3, Table 2): Massive anhydrites display nearly no macroscopically visible shear zones. Localized faulting is typical for stratified carbonate-anhydrite rocks (Fig. 2a). The shear zones in these rocks are usually normal faults that dip steeply to vertically (Fig. 3, Table 2). This indicates an extensive stress regime with low confining pressure. The ratio of displacement to thickness of these faults is comparable to tectonic faults. The highest fracture density occurs within massive brecciated dolomites (Fig. 2b, Table 2). Deformation in these rocks is more delocalized, the scattering in fault orientation and the number of fault embranchments per centimeter is large with respect to the layered carbonates (Table 2). These fault zones are often isochemical with respect to the host rock. Other shear zones, in particular in layered carbonate show an enrichment in pyrite and K-feldspar. This can be explained by a post-deformational fluid entrainment along permeable fracture zones.

Black and dark brownish layers (Fig. 2a, 4a) as well as dark coatings around anhydrite nodules (Fig. 4b) are zones enriched in organic matter. They are partly transformed to ductile shear zones with abundant flow features and foliation, and contain rounded porphyroclasts (Fig. 4a). The fine-grained matrix consist of potassium feldspar, pyrite, marcasite and apatite crystals and fragments which are embedded in a kerogen matrix. Dolomite shows grain reduction within the shear zones. Marcasite platelets mark the foliation. To develop such a ductile shear zone a low viscosity of the matrix and low strain rates are required. Ductile shear zone formation and mobilization of kerogen has started prior to the impact and was accelerated after the impact due to a thermal heating.

In summary, the sedimentary succession below the impactites is deformed to various degrees. The one-dimensional structural information of the drillcore makes it difficult to quantify the amount of collapse-induced displacements.

References: [1] Morgan J. et al. (1997) *Nature, 390* 472-476.

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Table 2. Characteristics of fault pattern o fFig. 2a (left) and Fig. 2b (right)

	Layered carbonate (1397,76 m	Dolomite breccia (1373,84 m)
fracture density (total fault length/area * 1000)	0.398	1.488
mean dip angle [°]	84.96	6.195
standard dev. of dip [°]	32.9	45.39
number of fault branch-offs / cm	5.77	11.35

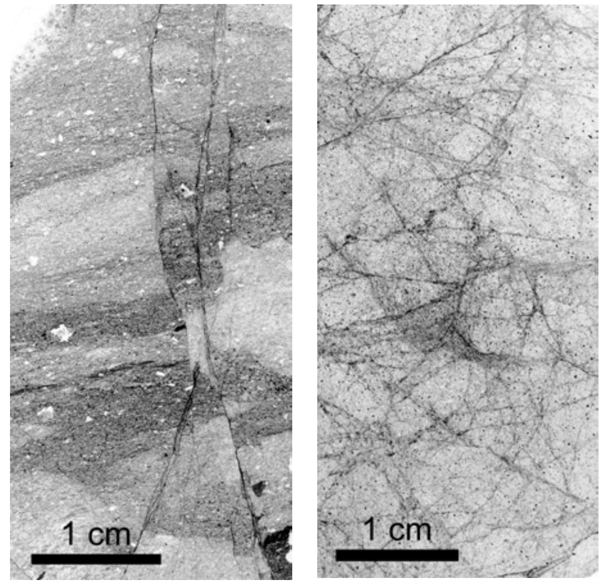

Fig. 2 Typical fracture pattern in (a) layered carbonates (Yax-1_1397,76 m, left) and (b) brecciated dolomites (Yax-1_1373,84 m, right)

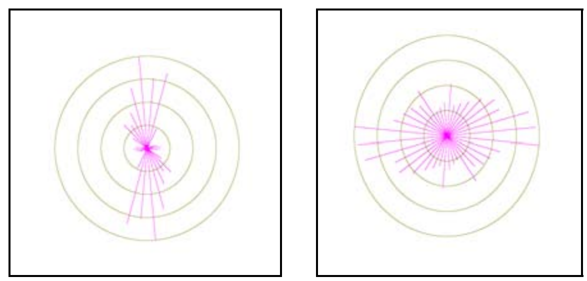

Fig. 3 Orientation analysis of Fig. 2a (left) and Fig. 2b (right).

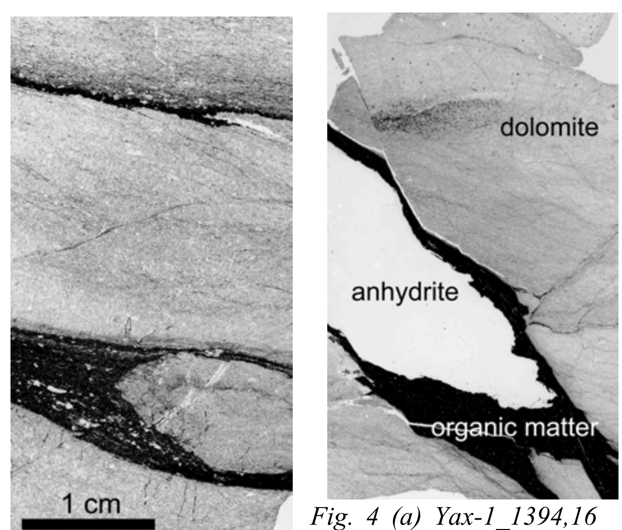

Fig. 4 (a) Yax-1_1394,16 (left).(b) Yax-1_1378,85m (right)